Claim 19, line 35, insert --retardance-- before "difference".

REMARKS

This Amendment is in response to an Office Action dated November 2, 1992. As May 2, 1993, falls on a Sunday, the six-month deadline is May 3, 1993. A request for a three-month extension of time, together with the required fee, accompanies this Amendment.

Applicant notes that the drawings have been objected to as being the wrong size. Applicant respectfully requests that correction of this informality be deferred until issuance of a Notice of Allowance.

First, Applicant has discovered that a nematic liquid crystal retarder can be caused to switch from a first retardance, corresponding to a first drive voltage, to a second retardance, corresponding to a second, higher drive voltage, by applying a drive voltage much higher than the second drive voltage until the second retardance is reached, then dropping to the second drive voltage. This is referred to herein as "impulse switching". It has also been discovered that, even though the liquid crystal actually relaxes back to a retardance corresponding to a lower drive voltage, rather than being actively driven by the electric field, relaxation will occur faster if the drive voltage is reduced below that required for the desired retardance until that

desired retardance is reached. Independent claims 1, 18 and 20 all incorporate this concept.

Second, it has been recognized that, over a predetermined operating range, two liquid crystal retarders starting at respective different retardances can be caused to relax to new respective retardances at nearly the same, linear rate. Where two retarders are arranged so that the net retardance of the two is the difference between the retardances introduced by each, that difference can be maintained while allowing both retarders to relax back to respective intermediate values between their maximum and minimum retardances. This allows the retardances of each retarder to be maintained within their respective ranges while the net retardance is being continuously changed. This concept is illustrated in Figures 10A-10I and incorporated in independent claims 14 and 21.

In the Office Action, the Examiner has rejected claims 8, 14, 15 and 19 under 35 U.S.C. § 112, asserting that the term "difference means" lacks proper antecedent basis and is ambiguous. Applicant respectfully traverses the Examiner's rejection.

First, the word "difference" is simply a convenient adjective for referring to the means plus function clause which follows. The meaning of that means plus function clause is described by the functional language, e.g., in claim 8:

> "means... for causing the total retardance of light passing through both said first retarder means and said second retarder means to be increased by changing the amplitude of the signal applied to one said retarder

means and to be decreased by changing the amplitude of the signal applied to the other said retarder means".

Second, the word "difference" is used in several locations in the specification to refer to this functional capability. That is, it is used at page 4, lines 10-12; page 5, lines 1-3; and at page 15, implicitly, in the equation at line 23. Therefore, it is submitted that the use of the term "difference" neither lacks antecedent basis nor renders the means plus function clauses of claims 8, 14, 15 and 19 ambiguous.

Nevertheless, to increase clarity, Applicant has amended each of claim 8, 14, 15 and 19 to refer to "retardance difference control means". This makes clear that it is the difference in retardance, i.e., the net retardance, that is being controlled. Accordingly, it is submitted that even if the Examiner's Section 112 rejection is well taken, it is overcome by these amendments.

The Examiner indicated that claims 16-17, which are dependent from claims 14 and 15, would be allowable if rewritten to overcome the rejection under 35 U.S.C. § 112 and to include all of the limitations of the base claim and any intervening claims. While claims 14 and 15 were rejected under Section 112 for the reasons stated above, they were not rejected on prior art. Accordingly, in light of the aforementioned amendments to claims 14 and 15, it is submitted that all of claims 14-17 are in condition for allowance.

Claims 1-7 and 20 were rejected under 35 U.S.C. § 103 as being unpatentable over Bos U.S. Patent No. 4,635,051 in view of Tsukamoto et al. U.S. Patent No. 3,891,307 and a reference to a

book by E. Kaneko entitled Liquid Crystal TV Displays: Principles and Applications of Liquid Crystal Displays. (Applicant and the undersigned greatly appreciate the Examiner's cooperation in promptly sending copies of the pertinent pages of Kaneko by facsimile at the request of the undersigned.) Applicant respectfully traverses this rejection for the reasons set forth below.

Claim 1 is an independent apparatus claim directed to impulse switching and claim 20 is an independent method claim generally corresponding to claim 1. Claims 2-7 depend ultimately from claim 1. None of these references discloses or suggests impulse switching. Bos '051 simply discloses two retarders arranged subtractively in series so that the net retardance is the difference between the retardance introduced by each of the two retarders. It teaches that, in switching either of those two retarders from a first retardance to a second retardance by increasing the drive voltage, the drive voltage is increased to that voltage corresponding to the second retardance. Bos simply does not recognize that faster switching can be obtained by first applying a drive voltage higher (or lower) than that corresponding to the second retardance and then reducing (or increasing) the drive voltage to that voltage corresponding to the second retardance when the second retardance is reached.

With respect to Kaneko, the Examiner has stated:

> "Lacking from the [Bos] disclosure for claims 1-6 is a drive means which exceeds the transition sustaining voltage. It was known at the time that rise time is inversely proportional to the torque on the liquid

> crystal molecules, which is in turn proportional to the square root of the driving voltage. It was also known to use a voltage which is higher than the transition voltage of the liquid crystal in order to shorten the rise time. Kaneko evidences this, teaching an equation for the rise time which assumes the driving voltage to be much larger than the transition voltage, and that it is inversely proportional to the square of the driving voltage..." (emphasis added).

But this merely describes a physical characteristic of liquid crystal material without in any way suggesting how that characteristic can be applied in a practical liquid crystal retarder system.

Moreover, the Examiner's statement reveals confusion of the "transition" or "threshold" voltage (V_{th} at page 20 in Kaneko), below which a liquid crystal cell does not change retardance, with the first retardance and second retardance referred to by Applicant, both of which lie in an operating range greater than the threshold voltage. Fundamentally, all Kaneko discloses is that if the voltage applied to a nematic liquid crystal cell used in a display (having a polarizer and analyzer) is greater than the threshold voltage, below which no change in retardance will occur, the rise time of the change in light transmission of the display is inversely proportional to the square of the applied voltage. Despite the desirability of rapid switching from one light level to another in optical displays, Kaneko fails to suggest any specific method for decreasing response time.

The prior art, as represented for example by Bos '051, teaches that, in switching from a first retardance to a second retardance by applying the higher drive voltage, the applied

higher drive voltage should be that voltage corresponding to the second retardance, not an even higher voltage. Indeed, the non-obviousness of Applicant's impulse switching is further supported by the fact that Bos was trying to increase the switching speed of a liquid crystal light value by using dual opposed retarders to switch the net retardance rapidly in either direction, yet failed to discover Applicant's impulse switching concept that would have increased switching speed in either direction even further.

Contrary to the Examiner's assertion, Tsukamoto et al. does not disclose impulse switching. In the first place, Tsukamoto et al. describes a cholesteric liquid crystal cell whose light transmission is adjusted, not a nematic liquid crystal cell whose retardance is adjusted. Second, in adjusting the light transmission of the cholesteric liquid crystal cell from a low level of light transmission to a target level of light transmission, the voltage applied is that which corresponds to the target level of transmission, which is maintained thereafter by reducing the voltage to slightly below the threshold voltage of the liquid crystal material. This is part of a matrix addressing scheme which requires the voltage to a given pixel to be reduced while still maintaining the level of light transmission by that pixel approximately constant for a period of time to prevent flicker. It does not disclose or suggest applying a higher voltage than that corresponding to the target

level of light transmission in order to decrease the switching time.

Accordingly, claim 1, claims 2-13 dependent therefrom, claim 18 and claim 20 are submitted to be in condition for allowance.

Claims 14 and 21 are all directed to adjusting the retardance of two subtractive series retarders to respective intermediate values between respective minimum and maximum retardances thereof so that the difference in retardance between the two is a predetermined amount. This allows the retardance range of each of the retarders to be adjusted while changes in net retardance are occurring, as described above. While claim 21 was rejected under 35 U.S.C. § 103 as being unpatentable over Fergason U.S. Patent No. Re. 32,521, it is noted that the same concept was incorporated in claims 14 and 15, which were not rejected over prior art.

In any case, Fergason does not disclose or teach this concept. Rather, Fergason merely discloses the use of two retarders in series for modulating an optical signal wherein the respective modulation signal voltages are 180° out of phase so that the amount of retardance introduced by the two retarders is additive. That is, in fact, the opposite of Applicant's invention wherein the amount of retardance introduced by the two respective retarders is subtractive. Moreover, Fergason discloses absolutely nothing about adjusting the retardance of the first and second retarders to respective intermediate values between respective minimum and maximum retardances so that the

difference in retardance between the two is a predetermined amount. Accordingly, it is submitted that claim 21, as well as claims 14 and 15, is in condition for allowance.

Therefore, the Examiner is respectfully requested to reconsider the rejections, allow claims 1-21 in this case and pass this case to issue.

Respectfully submitted,

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CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Hon. Commissioner of Patents and Trademarks, Washington, DC 20231, on this 3rd day of May, 1993.

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